[0014] The pixel sensing circuitry may be further capable of operating in a shielding mode by coupling the plurality of pixel sensing traces and the plurality of electrodes to the voltage reference. The finger sensor may further include a finger sensing integrated circuit (IC) coupled to the plurality of pixels sensing traces, for example.

[0015] The plurality of electrodes may each have a length shorter than a respective length of each of the plurality of pixel sensing traces, for example. The plurality of pixels may include a plurality of electric field sensing pixels.

[0016] The finger sensor may further include a dielectric substrate carried between the plurality of pixel sensing traces and the plurality of electrodes. The finger sensor may also include a dielectric cover overlying the plurality of electrodes.

[0017] A method aspect is directed to a method of finger sensing using a finger sensor that may include a plurality of pixels, a plurality of pixel sensing traces each associated with a respective pixel, and a plurality of electrodes overlying the plurality of pixel sensing traces. The method may include operating the finger sensor in a measurement mode by operating the plurality of pixels so that at least some of the plurality of pixels are active, and at least some other of the plurality of pixels are inactive, and coupling pixel sensing traces associated with the inactive pixels to a voltage reference. The method may also include operating the finger sensor in the measurement mode by coupling electrodes associated with the active pixels to the voltage reference, and coupling electrodes associated with the inactive pixels to a drive signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** is a schematic plan view of an electronic device including a fingerprint sensor for use with a touchscreen display in accordance with the present invention.

[0019] FIG. **2** is an exploded view of the fingerprint sensor of FIG. **1**.

[0020] FIG. **3** is a schematic diagram of electric field flux sensing pixel circuit for use with the fingerprint sensor of FIG. **2**.

[0021] FIG. **4** is a bottom view of a fingerprint sensor according to another embodiment of the present invention.

[0022] FIG. **5** is a top view of the fingerprint sensor of FIG. **4**.

[0023] FIG. **6** is a combined top and bottom view of the fingerprint sensor of FIGS. **4** and **5**.

[0024] FIG. **7** is a bottom view of a fingerprint sensor according to another embodiment of the present invention.

[0025] FIG. **8** is a greatly enlarged view of a portion of the fingerprint sensor of FIG. **7**.

[0026] FIG. **9** is a plan view of a drive/shield electrode arrangement of a fingerprint sensor in accordance with an embodiment of the present invention.

[0027] FIG. **10** is a top plan view of an arrangement of a conductive layer of the touchscreen display and the pixel sensing traces of an electronic device in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, and prime and multiple prime notation are used to indicate similar elements in different embodiments.

[0029] Referring initially to FIG. **1**, an embodiment of a fingerprint sensor **30** in accordance with the present invention is now described. The fingerprint sensor **30** is illustratively mounted in a stacked relation with or part of a display **52**. There is no array of input keys, as the display **52** is a touchscreen display so inputs are provided via the display. Of course, the fingerprint sensor **30** can also be used with other portable or stationary electronic devices.

[0030] The electronic device **50** includes a housing **51**, the display **52** carried by the housing, and circuitry **53** also carried by the housing and connected to the display and to the fingerprint sensor **30**. In some embodiments, an array of input keys are also provided and, where, for example, the electronic device **50** is in the form of a cellphone, may be used for dialing and other applications as will be appreciated by those skilled in the art.

[0031] The circuitry **53** may include a processor **57** and memory **55** coupled thereto, for example. The circuitry **53** may also include a wireless transceiver **56** configured to perform wireless communications functions, for example, voice and/or data communications. An antenna **58** is illustratively carried by the housing **51** and is coupled to the wireless transceiver **56**.

[0032] Of course, the fingerprint sensor **30** may also include circuitry embedded therein and/or in cooperation with the circuitry **53** to provide menu navigation and selection functions, tactile feedback, and/or power up functions as will be appreciated by those skilled in the art. In some embodiments, as will be described in further detail below, the fingerprint sensor **30** may be carried by or positioned in a staked relation with the display **52**, for example, for a touch screen display.

[0033] Referring additionally to FIG. **2** the fingerprint sensor **30** includes a fingerprint sensor integrated circuit (IC) **31**. Pixel sensing traces **33** are illustratively coupled to the fingerprint sensor IC **31** and extend outwardly therefrom to define a first metallization layer. As will be appreciated by those skilled in the art, for ease of explanation, the fingerprint sensor **30** illustrated in FIG. **2** includes one linear row of finger sensing pixels (each finger sensing pixels pixel corresponding to a respective pixel sensing trace **33**). Of course, the fingerprint sensor **30** may include any number of rows and columns of pixels and pixel sensing traces to define an array of finger sensing pixels. Alternatively or additionally, other configurations may include more than one fingerprint sensor and/or staggered arrangements of finger sensing pixels. The finger sensing pixels may be configured in other spatial relations.

[0034] A substrate **34** is carried by the pixel sensing traces **33**. More particularly, the substrate **34** is carried on top of or over the pixel sensing traces **33**. The substrate **34** is a dielectric substrate that may be transparent.

[0035] Drive/shield electrodes **35** are carried by the substrate **34**. Each drive/shield electrode **35** may function either as a finger drive electrode, or a trace shield electrode. The drive/shield electrodes **35** are carried on top of the substrate